CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 91-091
NPDES NO. CA0029289

WASTE DISCHARGE REQUIREMENTS FOR;

U.S. DEPARTMENT OF ENERGY
and
LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region, (hereinafter the Board) finds that:

1. Lawrence Livermore National Laboratories (LLNL) operates a research facility under contractual agreements with the U.S. Department of Energy (DOE). LLNL and DOE are both hereinafter referred to as dischargers. For the purposes of this Order, DOE will be responsible for compliance in the event that LLNL fails to comply with its requirements.

2. By a report dated April 1991, the dischargers have applied for a revision of their current waste discharge requirements to include groundwater disposal/recharge via an infiltration trench and injection wells. These requirements will be permitted under the National Pollutant Discharge Elimination System.

3. Hazardous materials have been used, stored, and disposed of on the property since it was first used by the federal government in the 1940's as a Naval Air Station, and later as a research for DOE and its predecessor, the U.S. Atomic Energy Commission.

4. Soil and groundwater beneath the site are polluted with chemicals and solvents that have either current or historical usage onsite. These pollutants include trichloroethylene, 1,1,1-trichloroethane, tetrachloroethylene, 1,1-dichloroethylene, 1,1-dichloroethane, carbon tetrachloride, and other halogenated and petroleum hydrocarbons.

5. Suspected sources of hazardous waste releases are form onsite landfills, spillage from outdoor storage facilities that existed throughout the site, leakage from underground storage tanks and pipelines, and past discharges to the LLNL storm drain system. Hazardous waste releases from current research or maintenance activities is not presently ongoing.

6. More than 300 monitoring wells have been installed by the dischargers, both onsite and offsite. Groundwater monitoring data indicate that the groundwater is polluted in several locations beneath the site and that a plume of polluted groundwater extends offsite from the southwest, flowing in a northwesterly direction.

7. Volatile organic compounds (VOCs) in the groundwater occur in large but relatively diffuse plumes that underlie about 85% of the LLNL site and cover a total of about 1.1 miles. VOC plumes are from 30 to 100 feet thick and are rarely found below a depth of 200 feet. VOCs have migrated offsite in two areas: about 2,500 feet west of Vasco Road onto private property and about 800 feet south of the South East Corner Area onto DOE property used by Sandia Laboratories.

8. This permit covers several investigative and remedial activities that will generate treated groundwater as waste. These activities are proposed to be conducted in both onsite and offsite areas, and include:

Short Term Discharge

a. Routine sampling - 3 to 5 well bore volumes removed from monitoring wells prior to obtaining regular groundwater samples for water quality analyses

b. Well development - preparation of new monitoring wells

c. hydraulic testing - 1 hour to 2 day pump tests

Long Term Discharge

a. Pilot study pump test - long term pump test to develop remedial design criteria

b. remedial treatment - subject to approval by EPA, but may consist of groundwater extraction and treatment prior to discharge at effluent limitations set by this Order.

9. Waste generated from routine sampling, well development, and hydraulic testing will reach flows ranging from approximately 800 to 40,000 gallons per day (gpd). These activities will most likely occur on an intermittent basis, but if all three activities are conducted simultaneously maximum flows may reach approximately 51,000 gpd.

10. Presently, two pilot study treatment facilities discharge about 180,000 gpd of treated wastewater. Of the 180,000 gallons, 144,000 will be discharged under separate Waste Discharge Requirements. When a permanent remedial alternative is selected by EPA, and it consists of groundwater extraction and treatment, remedial treatment may reach an anticipated total flow of approximately 504,000 gpd.

11. Treated waste groundwater will be discharged to the ground, to storm sewers which flow into Arroyo Seco or Arroyo Las Positas, or directly into the arroyos. When there is sufficient storm water flow in the arroyos, treated groundwater may flow through Alameda Creek into into San Francisco Bay north of the Dumbarton Bridge.

12. LLNL proposes to discharge treated waste groundwater to an infiltration trench west of Greenville Road in southern LLNL, and injections wells located 100 feet south of MW-441. The infiltration trench and injection wells will serve to expedite groundwater cleanup, hydraulically control existing VOC plumes, minimize anticipated water table decreases, and conserve groundwater resources.

13. The portion of the Livermore-Amador Valley groundwater basin which LLNL occupies, part of the Spring and Mocho I subbasins, is recognized as a groundwater recharge area in the San Francisco Bay Basin Plan and in technical reports submitted by the dischargers. One goal of this Order is to maximize retention of discharged groundwater within the Spring and Mocho I subbasins.

14. This Order will allow discharge of treated groundwater directly to the ground surface, into the surface drainage system (surface drainage channels, storm drains, Arroyo Seco, or Arroyo Las Positas), into an infiltration trench, or injection wells. Discharge from the pilot study treatment systems will be allowed under this permit until a permanent remedial alternative is selected by EPA,

15. The Board adopted a revised Water Quality Control Plan (Basin Plan) for the San Francisco Bay Region on December 17, 1986, The Basin Plan contains objectives and discharge prohibitions for the Livermore-Amador Valley and its subbasins.

16. The existing and potential beneficial uses for surface waters in the Livermore-Amador Valley groundwater basin including Arroyo Mocho, Arroyo Seco, Arroyo Las Positas, Arroyo de la Laguna and their tributaries are:

    a. Contact and non-contact water recreation,
    b. Wildlife habitat,
    c. Groundwater recharge, and
    d. Fish migration and spawning.

17. The existing and potential beneficial uses for groundwater underlying the Livermore-Amador Valley groundwater basins and its subbasins are:

    a. Municipal and domestic supply,
    b. Industrial supply,
    c. Industrial service supply, and
    d. Agricultural supply.

18. The Basin Plan prohibits discharge of wastewater which has "particular characteristics of concern to beneficial uses":

    a. "at any point where the wastewater does not receive a minimal initial dilution of at least 10:1 or onto any nontidal water, dead-end slough, similar confined water, or any immediate tributary thereof", and

    b. "to Alameda Creek (watershed) where no natural flow occurs."

19. The Basin Plan allows for exemptions to the prohibitions referred to in Finding 18 above when it can be demonstrated that a net environmental benefit can be derived as a result of the discharge.

20. LLNL's discharge can be exempt from the Basin Plan prohibition because it is an integral part of a program to clean up contaminated groundwater and thereby produces a net environmental benefit. Receiving water concentrations are expected to be below levels that would affect beneficial uses. Should studies indicate unanticipated chronic effects, the Board will review the requirements of this Order based upon Receiving Water Limitations B.1.e.

21. The Basin Plan prohibits discharge of "all conservative toxic and deleterious substances, above those levels which can be achieved by a program acceptable to the Board, to waters of the Basin." The dischargers' groundwater extraction and treatment system and associated operation, maintenance, and monitoring plan constitutes an acceptable control program for minimizing discharge of toxicants to waters of the State.

22. Effluent limitations of this Order are based on the Basin Plan, State plans and policies, U.S. Environmental Protection agency guidance, and best engineering and geologic judgement as to the best available technology that is economically achievable.

23. The issuance of waste discharge requirements for this discharge is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code (CEQA) pursuant to Section 13389 of the California Water Code.

24. The Board has notified the dischargers and interested agencies and persons of its intent to reissue waste discharge requirements for the discharge and has provided them with the opportunity for a public hearing and an opportunity to submit their written views and recommendations.

25. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the dischargers; in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Clean Water Act and regulations and guidelines adopted thereunder; shall comply with the following:

A. EFFLUENT LIMITATIONS

1. Any effluent discharged to the ground surface onsite shall:

   a. not exceed 10,000 gallons per day,

   b. be treated before discharge to meet concentrations of less than two times the action level for each compound specified by the California Department of Health Services, and

   c. be less than 100 ppb of total volatile organic compounds.

2. The effluent at the point of discharge to Arroyo Seco, Arroyo Las Positas, surface drainage channels, storm drains, LLNL infiltration trench, or LLNL injection wells shall not contain constituents in excess of the following:

Constituent	Unit	Instantaneous Maximum
Metals		
Antimony	ug/l	1460
Arsenic	ug/l	20
Beryllium	ug/l	0.7
Boron	ug/l	7000
Cadmium	ug/l	5
Chromium, Total	ug/l	50
Chromium +6	ug/l	11
Copper	ug/l	20
Iron	ug/l	3000
Lead	ug/l	5.6
Manganese	ug/l	500
Mercury	ug/l	1
Nickel	ug/l	7.1
Selenium	ug/l	100

Silver	ug/l	2.3
Thallium	ug/l	130
Zinc	ug/l	58
Volatile Organic Compounds (VOCs)		
Benzene	ug/l	0.7
Tetrachloroethylene	ug/l	4
Vinyl Chloride	ug/l	2
Total VOCs	ug/l	5

Total VOCs include but are not limited to:

Benzene, Bromoform, Carbon Tetrachloride, Chlorobenzene, Chlorodibromomethane, Chloroethane, Chloroform, 1,1-Dichloroethane, 1,2-Dichloroethane, Ethylbenzene, Tetrachloroethylene, Toluene, trans-1,2,-Dichloroethylene, 1,1,1-Trichloroethane, Trichloroethylene, trichlorofluoromethane, Xylene(s), and Vinyl Chloride.

Total Petroleum Hydrocarbons As identified by modified EPA Method 8015	ug/l	50
Ethylene Dibromide As identified by EPA Method 504	ug/l	0.02
Polynuclear Aromatic Hydrocarbons Total, as identified by EPA Method 610 or 625	ug/l	15
Base/Neutral, Acid, and Pesticide Compounds Per constituent, as identified by EPA Method 610 or 625	ug/l	5

3. The pH of the discharge shall not exceed 8.5 nor be less than 6.5.

4. In any representative set of samples, the discharge of wastes shall meet the following limit of quality:

TOXICITY: The survival of test fishes acceptable to the Executive Officer in 96-hour bioassays of the effluent as discharged shall be a median of 90% survival and a 90 percentile value of not less than 70% survival.

B. RECEIVING WATER LIMITATIONS

1. The discharge of wastes shall not cause the following conditions to exist in waters of the State at any place:

a. floating, suspended, or deposited macroscopic particulate matter or foam;

b. bottom deposits or aquatic growths;

c. alteration of temperature or apparent color beyond present natural background levels;

d. visible, floating, suspended, or deposited oil or other products of petroleum origin; and

e. toxic or deleterious substances to be present in concentrations or quantities which will cause deleterious effects on aquatic biota, wildlife, or water fowl, or which render any of these unfit for human consumption at levels created in the receiving water or as a result of biological concentrations.

2. The discharge of waste shall not cause the following limit to be exceeded in waters of the State within one foot of the water surface:

pH: The pH shall not be depressed below 6.5 nor raised above 8.5, nor caused to vary from normal ambient pH levels by more than 0.5 pH units.

3. This discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Board or the State Water Resources Control Board as required by the Federal Water Pollution Control Act and regulations adopted thereunder. If more stringent applicable water quality standards are promulgated or approved pursuant to Section 303 of the Federal Water Pollution Control Act or amendments thereto, the Board will revise and modify this Order in accordance with the more stringent standards.

C. PROVISIONS

1. The dischargers shall comply with all sections of this Order immediately upon adoption. For the purposes of enforcing this Order, DOE shall be responsible for achieving full compliance with this Order within 60 days of the Executive Officer's determination that LLNL has failed to comply with the requirements of this Order.

2. The dischargers shall comply with the self-monitoring program as adopted by the Board and as may be amended by the Executive Officer.

3. Board Order 90-106 is hereby rescinded.

4. The dischargers shall notify the Board if the Self-monitoring program results indicate, or if discharge or any activity (to include all site investigation activity) has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited by this Order.

5. Discharge of treated groundwater to the ground may occur only:

a. within LLNL legal site boundaries while conducting routine sampling, well development, or hydraulic testing,

b. if the total effluent volume does not exceed 10,000 gallons per day,

c. if the total VOCs in the discharge do no exceed concentrations of two times the action level for each compound specified by the California Department of Health Services, or does not exceed the limit under Effluent Limitation A.1, and

d. in offsite areas while conducting routine sampling, well development, or hydraulic testing if it has been shown that the pumped water contains VOC concentrations less that those listed in Item a.2 and permission is obtained from the owners.

6. Discharge of treated waste groundwater to the storm sewers may occur only:

a. within LLNL legal site boundaries,

b. in offsite areas if the discharge point to a waterway can be identified, and a receiving water sample point is established (if the new discharge point is downstream from all existing receiving water sample points) as discussed under item I.C., Part B, Self-monitoring program.

c. for any investigative or remedial activity that generates effluent at all volumes, and

d. if the discharge complies with all Effluent Limitations.

7. Discharge of treated waste groundwater to the Arroyo Seco, Arroyo Las Positas, LLNL infiltration trench, or LLNL injection wells may occur only:

a. in offsite or onsite areas,

b. for any investigative or remedial activity that generates effluent at all volumes, and

c. if the discharge complies with all Effluent Limitations.

8. Total discharge from all pilot studies treatment systems shall not exceed 360,000 gallons per day. Discharge from the pilot studies will be allowed under this permit until a Record of Decision for final remediation has been reached.

9. Effluent generated from treatment Facility A shall not be discharged at any point of the arroyo that crosses or is upstream of the main body of the offsite plume unless the channel is lined to prevent infiltration from the point of discharge downstream through the body of the plume. Discharge from treatment Facility A will be managed under separate Waste Discharge Requirements.

10. Any discharge to a location other than the discharge point(s) specified in Provisions 5 through 7 of this Order, or discharge of any hazardous constituent, will require a modification of this Order or submission of a second NPDES application.

11. For additional injection wells, the dischargers must submit a report describing well locations, well construction, and other information to show that discharge from the additional wells have adequate hydraulic control and monitoring. This report shall be to the satisfaction of the Executive Officer.

12. The dischargers shall comply with all items of the attached "Standard Provisions & Reporting Requirements, and Definitions dated December, 1986 except items A.10, B.2, C.8, and C.11.

13. This Order expires June 18, 1996. The dischargers must file a report of waste discharge in accordance with Title 23, Chapter 3, Subchapter 9 of the California Administrative Code no later than 180 days in advance of such expiration date as application for issuance of new waste discharge requirements.

14. This Order is issued to the dischargers in support of investigation and cleanup activities undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. Pursuant to CERCLA, all response actions taken by the dischargers must be consistent with guidelines, rule regulations, and criteria developed by the EPA. Issuance of this Order does not constitute approval by the State of California or EPA for any response activities. This Order is meant to facilitate the investigation of the extent of pollution, the evaluation of potential remedies, and the initiation of any selected remedies by specifying the manner in which waste groundwater from investigation and cleanup activities may be discharged.

15. This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Clean Water Act or amendments thereto and shall become effective 10 days after the date of its adoption provided the Regional Administrator, EPA has no objection. If the Regional Administrator objects to its issuance, the permit shall not be effective until such objection is withdrawn.

I, Steven R. Ritchie, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region on June 19, 1991.

Steven R. Ritchie
Executive Officer

Attachments:

a. Standard Provisions & Reporting Requirements, Dec 1986
b. Self-Monitoring Program

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

SELF-MONITORING PROGRAM
FOR:

U.S. DEPARTMENT OF ENERGY

and

LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

NPDES NO. CA 0029289
ORDER NO. 91-091

CONSISTS OF:

PART A, January 1987

and PART B, Adopted June 19, 1991

PART B

U.S. DEPARTMENT OF ENERGY
and
LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, ALAMEDA COUNTY

I. DESCRIPTION OF STATIONS

A. INFLUENT

Station	Description
I-001	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility A; immediately prior to treatment.
I-002	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility B; immediately prior to treatment.
I-003	At a point in ground water extraction, collection, and treatment utilizing Treatment Facility C; immediately prior to treatment.
I-004 to I-XXX	At a point in groundwater extraction and treatment that uses a single or multiple well treatment system, immediately prior to treatment. These points will be assigned by the dischargers to all monitoring or extraction wells listed in Finding 8 of Board Order 91-XXX when such activities are initiated. Once assigned, each number will be used in all future extraction events for the same well.

B. EFFLUENT

Station	Description
E-001	At a point in ground water extraction and treatment using Treatment Facility A; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-002	At a point in ground water extraction and treatment using Treatment Facility B; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-003	At a point in ground water extraction and treatment using Treatment Facility C; immediately following treatment and prior to discharge to surface waters or drainage ways.
E-004 to E-XXX	At a point in groundwater extraction and treatment that uses a single or multiple well treatment system, immediately following treatment and prior to discharge onto the ground site storm drain systems, surface waters, drainage ways, or injection wells. These points will be assigned by the dischargers to all monitoring or extraction wells listed in Finding 8 and provisions 5 to 7 of Board Order 91-XXX when such activities are initiated. Once assigned, each number will be used in all future extraction events for the same well.

C. RECEIVING WATERS

Station	Description
R-001	At a point in the north flowing drainage ditch east of Vasco Road, between 50 and 100 feet downstream from the effluent discharge point for Treatment Facility B.
R-002	At a point in Arroyo Seco between 50 and 100 feet downstream from the effluent discharge point for Treatment Facility C.
R-003 to R-XXX	At a point in Arroyo Las Positas, Arroyo Seco, or any surface drainage way between 50 and 100 feet downstream from the effluent discharge point established by the dischargers

II. SCHEDULE OF SAMPLING AND ANALYSIS

The schedule of sampling and analysis is provided in Table 1.

III. MODIFICATIONS TO PART A

A. ADDITIONS

Add Section E.1.e.3) to read:

Stream gage height measurements and their conversion to stream flow measurements.

B. DELETIONS

Sections D.2.b., D.2.g., E.1.e.1), E.3., and E.4.

C. MODIFICATIONS

All items of Self Monitoring Program Part A, dated January 1987 shall be complied with except for the following modifications:

1. Section D.2.a. shall be changed to read as follows:

   Samples of effluent shall be collected on days coincident with effluent grab samples unless otherwise stipulated. The Board or Executive Officer may approve an alternative sampling plan if it is demonstrated to the Board's satisfaction that expected treatment facility operation warrant a deviation from the standard sampling plan.

2. Section D.2.e. shall be changed to read as follows:

   If the instantaneous maximum limit is exceeded, the sampling facility shall be increased to daily until two samples collected on consecutive days show compliance with the instantaneous maximum limit.

3. Section D.3.b. shall be changed to read as follows:

3. Section D.3.b. shall be changed to read as follows:

   Receiving water samples shall be collected at each station on each sampling day. Samples shall be collected within the discharge plume and downcurrent of the discharge point so as to be representative, unless otherwise stipulated.

4. In Section F.1., the phrase:

   > "... shall be maintained by the dischargers and accessible (at the waste treatment plant) ..."

   shall be changed to read as follows:

   > "... shall be maintained by the dischargers and accessible (at the dischargers' facility) ..."

5. Information requested in Section G.4.e. shall be prepared in a format similar to EPA form 3320-1 and shall be submitted to the EPA's Superfund Division rather than the Enforcement Division.

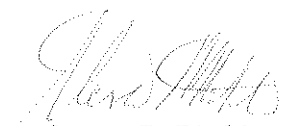
6. Tha Annual Report required in Section G.5. shall be submitted in place of the end of year monthly report.

I, Steven R. Ritchie, Executive Officer, hereby certify that the foregoing Self-Monitoring Program:

1. Has been developed in accordance with procedures set forth in this Regional Board's Resolution No. 73-16 in order to obtain data and document compliance with waste discharge requirements established in Regional Board Order No 91-091.

2. Was adopted by the Board on June 19, 1991, and

3. May be reviewed at any time subsequent to the effective date upon written notice from the Executive Officer or request from the dischargers, and revisions will be ordered by the Executive Officer or the Regional Board.



Steven R. Ritchie
Executive Officer

Attachments:
1. Table 1
2. Site Map

TABLE 1

SCHEDULE FOR SAMPLING, MEASUREMENTS, AND ANALYSIS

Sampling Station	1001-1003, 1XXX	1004-1XXX		E001-E003	E004-EXXX		R001-R002	R003-RXXX					
TYPE OF SAMPLE	G	G		G	G		G	G					
Flow Rate (mgd)	D	D		D	D		D	D					
BOD, 5-day, 20°C, or COD (mg/l & kg/day)													
Chlorine Residual & Dosage (mg/l & kg/day)													
Settleable Matter (ml/l-hr. & cu. ft./day)													
Total Suspended Matter (mg/l & kg/day)													
Oil and Grease (mg/l & kg/day)													
Coliform (Total or Fecal) (MPN/100 ml) per req't													
Fish Tox'y 96-hr. % Surv'l in undiluted waste				Q	Q		2/Y	2/Y					
Ammonia Nitrogen (mg/l & kg/day)													
Nitrate Nitrogen (mg/l & kg/day)													
Nitrite Nitrogen (mg/l & kg/day)													
Total Organic Nitrogen (mg/l & kg/day)													
Total Phosphate (mg/l & kg/day)													
Turbidity (Jackson Turbidity Units)				Q	Q		2/Y	2/Y					
pH (units)	M	M		M	M		M	M					
Dissolved Oxygen (mg/l and % Saturation)													
Temperature (°C)				M	M		M	M					
Apparent Color (color units)													
Secchi Disc (inches)													
Sulfides (If DO<5.0 mg/l) Total & Dissolved (mg/l)													
Arsenic (mg/l & kg/day)	I/S	I/S		I/S	I/S		I/S	I/S					
Cadmium (mg/l & kg/day)	*	*		*	*		*	*					
Chromium, Total (mg/l & kg/day)	*	*		*	*		*	*					
Copper (mg/l & kg/day)	*	*		*	*		*	*					
Cyanide (mg/l & kg/day)	*	*		*	*		*	*					
Silver (mg/l & kg/day)	*	*		*	*		*	*					
Lead (mg/l & kg/day)	*	*		*	*		*	*					
Antimony, Berrylium, Boron, Iron, Manganese, Selenium, Thallium (mg/l & kg/day)	*	*		*	*		*	*					
Gross Alpha Particles, Gross Beta Particles, Tritium (pCi/l)	*			I/A	I/A		I/A	I/A					

TABLE I (continued)

SCHEDULE FOR SAMPLING, MEASUREMENTS, AND ANALYSIS

...g Station	I001-I003	I004-IXXX		E001-E003	E004-EXXX		R001-R002	R003-RXXX					
...PE OF SAMPLE	G	G		G	G		G	G					
...ercury ...g/l & kg/day)	I/S	I/S		I/S	I/S		I/S	I/S					
...ckel ...g/l & kg/day)	"	"		"	"		"	"					
...inc ...g/l & kg/day)	"	"		"	"		"	"					
...ENOLIC COMPOUNDS ...g/l & kg/day)													
...ll Applicable ...andard Observations				E	E		E	E					
...ottom Sediment Analyses ...nd Observations													
...otal Identifiable Chlorinated ...ydrocarbons (mg/l & kg/day)													
...PA 601 (ug/l & kg/l)	W/M	W/M		D/W	D/W		W/M	W/M					
...PA 624 (ug/l & kg/l)	I/A*	I/A*		I/A*	I/A*								
...PA 6?? & 625 (ug/l & kg/l)	I/A*	W/M		I/A	D/W		I/A	W/M					
...otal Dissolved Solids & ...h... ides (mg/l & kg/l)***	Q	Q		Q	Q		Q	Q					

* When EPA 624 is performed, it is not necessary to perform EPA 601

LEGEND FOR TABLE

TYPES OF SAMPLES

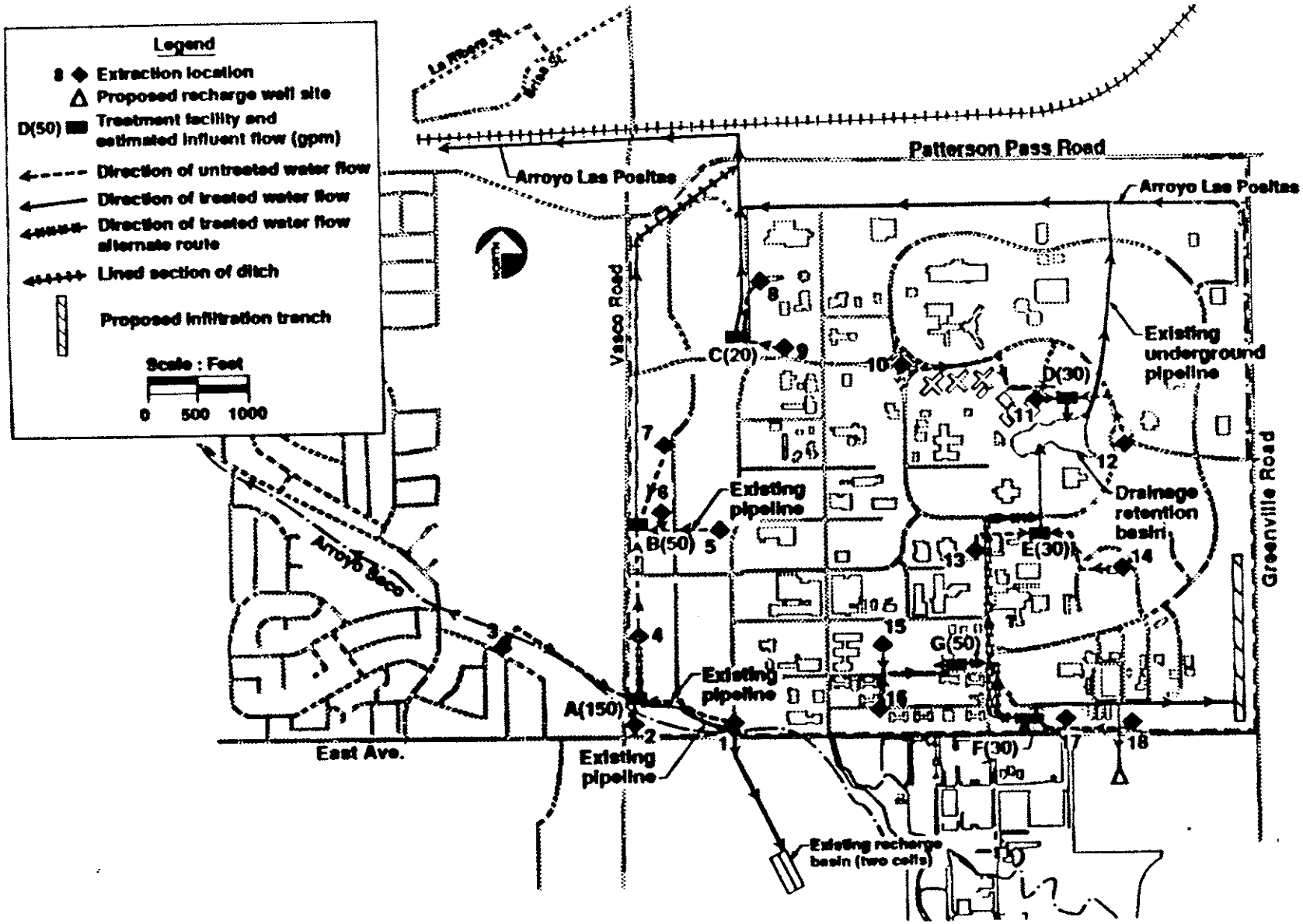
G = grab sample
C-24 = composite sample - 24-hour
C-X = composite sample - X hours (used when discharge does not continue for 24-hour period)
Cont = continuous sampling
DI = depth-integrated sample
BS = bottom sediment sample
O = observation

TYPES OF STATIONS

I = intake and/or water supply stations
A = treatment facility influent stations
E = waste effluent stations
C = receiving water stations
P = treatment facilities perimeter stations
L = basin and/or pond levee stations
B = bottom sediment stations
G = groundwater stations

FREQUENCY OF SAMPLING

E = each occurence
H = once each hour
D = once each day
W = once each week
M = once each month
Y = once each year
= Daily for the first week, weekly thereafter
W/M = Weekly for the first 4 weeks, monthly thereafter
I/A = One sample during the first week of discharge, annually thereafter
I/S = One sample during the first week of discharge, semi-annually thereafter
2/H = twice per hour
2/W = 2 days per week
5/W = 5 days per week
2/M = 2 days per month
2/Y = once in March and once in September
Q = quarterly, once in March, June, Sept. and December
2H = every 2 hours
2D = every 2 days
2W = every 2 weeks
3M = every 3 months
Cont = continuous



Preliminary ground water extraction and treatment facility locations (modified from Isherwood *et al.*, 1990).